Vol. 105 No. 8 April 19, 1947

The American FERTILIZER

Published every other Saturday. Annual subscription: in the United States, $3.00; Canada and Mexico. $4.00; other countries, $5.00. Entered as second-class matter. January 15 1910, at the Post Office at Philadelphia. Pa., under Act of March 3, 1879. Registered in United States Patent Office. Publication office. 1900 Chestnut St.. Phila, 3 Pa.

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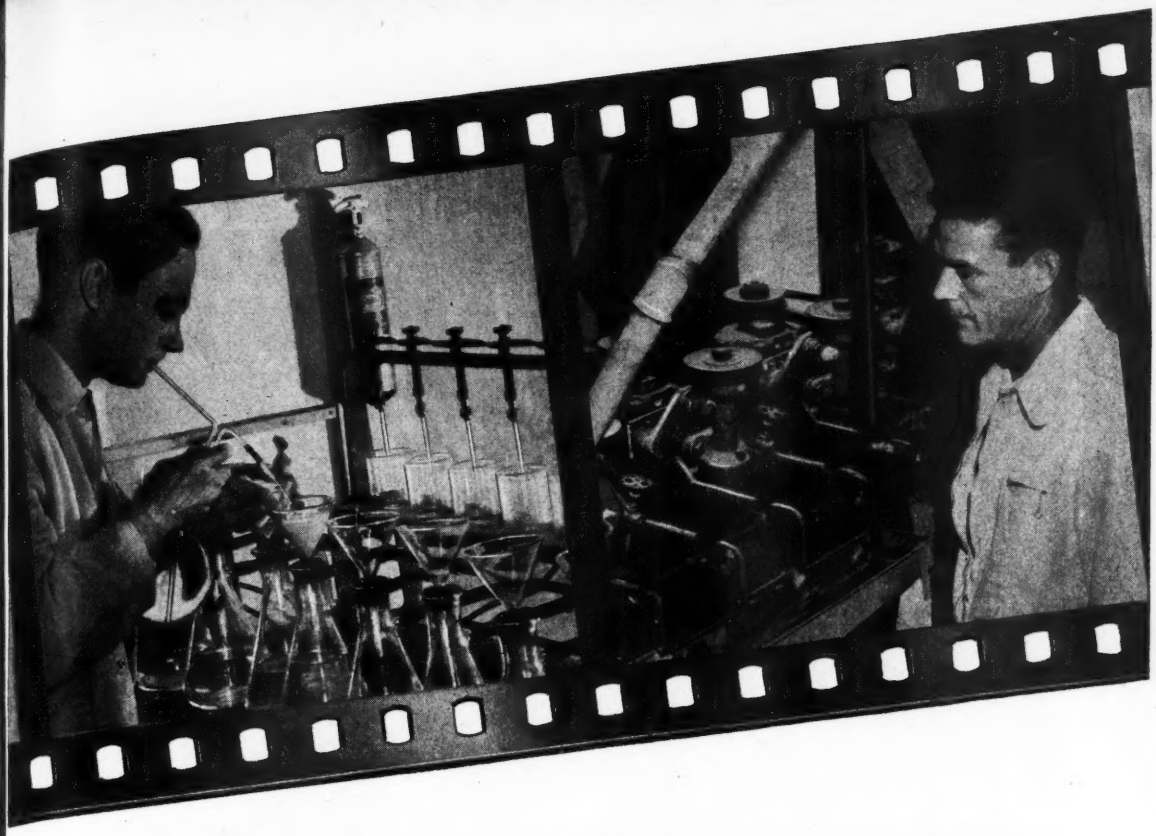

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The American FERTILIZER

Vol. 106 APRIL 19, 1947 No. 8

Explosibility and Fire Hazard of Ammonium-Nitrate Fertilizer

By R. O. E. DAVIS

Principal Chemist, Division of Soil and Fertilizer Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration

EDITOR'S NOTE: *Involved in the recent disaster at Texas City, Texas, were explosions on two vessels which were loaded in part with ammonium nitrate for export shipment. In order to guide the industry in the handling of this material and in the hazards connected with it, we present extracts from a report (Circular No. 719) made by the U. S. Department of Agriculture in 1945. Copies of the complete report can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at a cost of 10 cents each.*

SUMMARY

Explosion Hazard

AMMONIUM nitrate is employed both as a nitrogen fertilizer and as a high explosive, but a high-velocity detonator in sufficient quantity is required to energize the mass of the material.

Under favorable conditions of pressure, rapid heating, and retention of heat, ammonium nitrate may be exploded partially from heat alone near 300° C. (572° F.), but Munroe failed to find any instance of explosion of the salt in ordinary containers or in bulk when involved in large conflagrations of buildings or cargo vessels.

Explosion by impact or friction is very difficult and requires favorable conditions obtained by design. Sensitivity is decreased by the presence of alkalies and alkaline earths and is increased by the presence of acid, as nitric acid formed in decomposition of ammonium nitrate at a moderately low temperature.

Ammonium nitrate-ammonium sulfate mixture in 50–50 proportion gave negative results in falling-weight, friction, and detonation tests, as was true also of mixtures with other ammonium salts and with superphosphate.

Explosibility is decreased by the presence of inert, nonoxidizable materials. An explosion tends not to be propagated throughout the mass unless energized from without. Thermal decomposition, beginning below 100° C. (212° F.), is endothermic, and not until the temperature of the decomposing salt reaches about 260° to 350° C. (500° to 662° F.) does the reaction become sufficiently exothermic to produce heat in excess of that absorbed by adjacent quantities of decomposing salt. Below this the explosive wave is not propagated.

Large grains or spherical granules tend to decrease the explosibility of ammonium nitrate as well as of other explosives.

Ammonium nitrate is not considered explosive under transportation conditions or when stored in wooden receptacles or paper bags by itself and apart from other explosive substances.

Fire Hazard

Ammonium nitrate in bulk offers much the same fire hazard as sodium nitrate; that is, mostly an indirect hazard from the liberation of oxygen at moderately high temperatures, which tends to increase the intensity and spread of a fire.

Readily oxidizable metallic powders in contact with wet ammonium nitrate may result in spontaneous combustion. Zinc powder seems to be most reactive under such conditions.

The presence of 5 per cent aluminum, iron, or zinc powder with dry material does not appreciably increase its inflammability. Experiments with 5 per cent charcoal produced no burning by direct contact with a flame, but with 11 per cent charcoal it burned with very small flame. With 5 per cent wood powder decomposition occurred without flame.

With the addition of paraffin up to 30 per cent, heating on a steel plate caused fuming and decomposition and in one test at 300° C. (572° F.) a small flame.

Bags impregnated with nitrate-sulphate, 40–60, are more combustible than ordinary burlap bags. Strips of paper and burlap impregnated with ammonium nitrate and sodium nitrate are more combustible than untreated fabric, but both nitrates increase combustibility to about the same extent.

Organic or other easily oxidizable substances impregnated or in contact with ammonium nitrate produce violent combustion on ignition.

Copper is the only common metal that reacts appreciably with molten ammonium nitrate, producing nitrite, which is less stable than nitrate, and increasing the tendency to violent conflagration or explosion.

Decomposition of ammonium nitrate at temperatures below 100° C. into ammonia and nitric acid produces a greater fire hazard under some conditions in mixtures than is found in sodium nitrate.

Mixtures containing superphosphate, ammonium nitrate, and organic meal may give rise to spontaneous combustion from oxidizing reactions that sometimes begin at ordinary room temperatures. Ignition takes place when the temperature reaches 90° to 95° C. (194° to 203° F.). Neutralization with ammonia removes this hazard.

Uses of Ammonium Nitrate

Nitrogen is a constituent of most explosives, an essential fertilizer for plant growth, and an element required for the nutrition of man and animals. Ammonium nitrate, 35 per cent nitrogen, is an important explosive and also an excellent nitrogen fertilizer. It has been used for many years for both purposes. In the explosives industry it is usually employed either as the pure compound or in combustion with TNT or other explosive materials. The fertilizer industry has used ammonium nitrate mixed with limestone to make Cal-Nitro or similar mixtures and in ammonia-water solution as Nitrogen Solution.

During the 1943–1944 fertilizer season, as a result of conversions by war plants, large quantities of ammonium nitrate (93 to 95 per cent pure) were made available for the manufacture of fertilizers and as a nitrogen fertilizer for direct use on farms. In such use the question is frequently raised as to the explosion and fire hazards involved. It is the purpose of this circular to review the evidence bearing on the subject and to make recommendations for handling ammonium nitrate in fertilizer factories and on farms.

Explosion Hazard

Ammonium nitrate is explosible by subjection to a very strong initial impulse, as the detonation of TNT or tetryl. It is also explosible by the application of heat, but this is difficult to accomplish in other than an enclosed space, such as a bomb that retains heat and pressure. There are at least six physical factors that in general influence sensitivity toward explosion: (1) Temperature, (2) strength of initial impulse, (3) density, (4) packing, (5) particle size, and (6) moisture content of the material. Moreover, the acid condition increases sensitivity, as does the presence of such easily oxidizable material as aluminum powder or organic materials. On the other hand, the presence of an alkali or alkaline earth is reported as tending to desensitize ammonium nitrate.

Under conditions of high temperature, great initial impulse, such as a large detonating charge, and high density of material, the explosibility of ammonium nitrate is increased, while increases in particle size and moisture content tend to reduce its sensitivity toward explosion from shock or heat.

Under rare conditions of high temperature and pressure it is possible for ammonium nitrate alone to explode. The likelihood of these conditions occurring, however, is remote and can be avoided with reasonable caution.

Detonation

Some stimulus is generally necessary for the explosion of a material, but the intensity

of the stimulus varies widely, according to the character of the explosive. Low explosives or propellants are combustible and contain oxygen necessary for their own combustion, with the production of sufficient heat to sustain the reaction. In contrast, a high explosive, of which ammonium nitrate is one, will explode under sufficient shock by a primary explosive or detonator. High explosives generally burn quietly in small quantities; they are not readily exploded by heat or shock. Ammonium nitrate under ordinary conditions is inert and can be exploded only through detonation, and then only by using as detonator a quantity of some explosive sufficient to initiate an explosive wave of very high velocity. This makes the storage of ammonium nitrate under ordinary conditions relatively free from explosion hazard, but caked material should not be broken up by blasting under any circumstances.

Addition of Organic Materials and Oxidizable Powders

Heating ammonium nitrate alone and with impurities to determine the flash point showed that ammonium nitrate alone decomposed completely between 245° and 340° C. (473° and 644° F.) without flame but with red fumes, 5 per cent paraffin gave decomposition without flame at 270° C. (518° F.), and 30 per cent paraffin gave a flame one time in three tests at 300° C. (572° F.); in other cases decomposition occurred without flame. Mixed with ammonium nitrate and heated to 240° to 250° C. (482° F.), 5 per cent aluminum, iron, and zinc powders each gave decomposition and deflagration without sustained flame. These experiements indicate a reduction of explosion hazard by the presence of small quantities of paraffin, but oxidizable metal powders increase the explosion hazard by lowering decomposition temperatures.

Considerable interest attaches to the use of waxy materials for coating as a possible source of danger, increasing the sensitivity of ammonium nitrate as an explosive or a fire hazard. Ammonium nitrate with 5 per cent paraffin decomposes at a considerably higher temperature than without any addition. This is in line with a report by Bezold that paraffin is employed for decreasing moisture absorption, but it also decreases explosibility. Coating ammonium nitrate with about 1 per cent of petrolatum-rosin-paraffin mixture does not appreciably increase explosibility.

It is reported by Marchand that molten ammonium nitrate does not react with aluminum, iron, mercury, or tin, but it does react with bismuth, cadmium, copper, magnesium, lead nickel, and zinc. Cadmium and copper are most reactive. These metals form nitrates and set free hydrogen, which reduces some nitrate to ammonium nitrite. This much less stable compound increases the explosion hazard. Care should, therefore, be taken to keep these metals away from stored ammonium nitrate. Inasmuch as cadmium is present in zinc, which is used in all galvanizing work, the use of galvanized vessels or storage in contact with the galvanized siding of buildings should be avoided.

Fire Hazard

Special attention has been given to the fire hazards presented in the storage and handling of ammonium nitrate and its mixtures prepared for fertilizer use. Munroe and the Underwriters' Laboratories made many tests, in order to establish as nearly as possible the hazards from ammonium nitrate alone, its mixture with ammonium sulphate as represented by Leunasalpeter, and with ground limestone as in Cal-Nitro. The conclusion arrived at by each was that ammonium nitrate, like nitrates in general, presents a fire hazard of the same order as from sodium nitrate.

Combustion of Ammonium Nitrate Alone

All nitrates furnish oxygen to support combustion, and explosive nitrates will burn under some conditions if they contain oxidizable elements, and will partially support their own combustion, which may result in an explosion. Ammonium nitrate is in this class, but, as already shown, this requires confinement, a high temperature, and a high density of material. These are generally produced only by intentional arrangement, and under most conditions the explosive wave will not follow broken masses. For the same reason, heat is not usually generated in sufficient quantity to support combustion of ammonium nitrate alone. It may be ignited by organic matter associated with it and may burn and furnish sufficient heat, but ignited ammonium nitrate alone will soon cease burning from loss of heat. Since over-all reactions in decomposition are mostly endothermic below 260° C. (500° F.), it requires more heat than is generated by the reactions to continue the decomposition.

In a number of tests by Munroe, where fires were started from free flames or by detonation, ammonium nitrate contained in wooden barrels was fused, scattered, or partly burned, but the fire did not spread throughout the mass. Often unchanged ammonium

nitrate remained with unconsumed parts of barrels. A recent test carried out by the Consolidated Mining & Smelting Corporation of Canada and reported by the Allied War Supplies Corporation, Montreal, showed that 10 pounds of ammonium nitrate, sprinkled with gasoline in a paper bag and ignited, burned quietly and left a mass of partly fused ammonium nitrate with some of the unburned paper bag. A second test was made with similar material, except that enough gasoline was added to make a slurry with the salt. This was placed on a pile of wood soaked with gasoline and ignited. Burning was brisk but not fierce; molten ammonium nitrate dripped on incandescent coals and burned, but no evidence of explosion was obtained.

Similar tests have been made at the Plant Industry Station of the Agricultural Research Administration, at Beltsville, Md., using 10 pounds of ammonium nitrate with essentially the same results. In one test, after the pile of wood had been reduced almost to a bed of coals, additional fuel was piled on and another 5 pounds of ammonium nitrate added. The fire burned rapidly and the ammonium nitrate melted, flowed over the hot coals, and burned, giving off reddish-brown fumes. The ammonium nitrate was completely decomposed, but there was no evidence of explosion. Evidence by other experimenters, showing the presence of undecomposed ammonium nitrate remaining after explosions or fires had started from organic combustibles, indicates that while the salt may add to the intensity of a fire after it has reached a high temperature it does not of itself propagate flame readily.

Influence of Added Materials

Fire tests by A. H. Nucholls, of the Underwriters' Laboratories, Inc., were performed with mixtures of ammonium nitrate and ammonium sulphate in the ratio of 40–60 (base No. 1) and of ammonium nitrate and calcium carbonate in the ratio of about 60–40 (base No. 2), mainly to determine the violence of the reaction that occurs under fire conditions when these products are in contact with sawdust or other organic matter. Tests were made also with burlap bags used previously for storage of the ammonium nitrate-ammonium sulphate mixture and bags used for sodium nitrate.

Tests made with 40-pound samples of nitrate-sulphate and nitrate-carbonate mixtures alone and with slightly smaller samples mixed with sawdust. Each sample was placed in a cylindrical brick furnace, 11 inches inside diameter and 15 inches high, surrounded by a metal cylindrical shield, 22 inches in diameter and 35 inches high.

Three 6-inch equidistant circular openings in the side of the brick furnace near the bottom were temporarily covered by ¼-inch boards when the test sample was placed in the furnace. The sides of the metal shield carried corresponding openings through which flames 4 feet long and one foot in diameter were directed from kerosene blow-torches operated by compressed air. A thermocouple inserted in the ammonium-nitrate mixture indicated temperatures during initial stages of a test. The three torches were started at the same time, and the wood covers on the openings in the brick furnace burned, permitting the flames to impinge directly on the material under test. Three tests were made with base No. 1 alone and one test with 30 pounds of base No. 1 mixed with 7 pounds of sawdust. Two tests were made with base No. 2 alone and one with No. 2 mixed with 2¼ pounds of sawdust.

With ammonium nitrate-ammonium sulphate (No. 1) and sawdust mixed in, the samples melted and decomposed to some extent. Odors of ammonia, sulphur dioxide, and some sulphur trioxide were recognized. The maximum temperature observed was 668° C. (1234° F.). A black carbonaceous residue remained with the sawdust. Similar observations were made with base No. 2, except that the highest temperature was 979° C. (1794° F.). In no case were brown fumes observed, and the samples did not react violently or explode. Sawdust did not seem to increase the violence of the reaction, but left a charred residue. The absence of brown fumes and the presence of charred residue indicate a deficiency of oxygen under the conditions of these tests. With free access of air, as might occur in accidental fires, the reactions would probably be somewhat more violent.

Spontaneous Combustion Due to Ammonium Nitrate

It has been found in this laboratory that certain mixtures of ammonium nitrate, organic materials, and superphosphate are subject to spontaneous combustion. A mixture composed of 1,400 pounds of ordinary superphosphate, 400 pounds of ammonium nitrate, and 200 pounds of peanut-hull meal ignites spontaneously when the mass is heated in an oven until the temperature nears 90° to 95° C. (194° to 203° F.). Decomposition of ammonium nitrate and reaction with superphosphate liberates free nitric acid. A chain

(Continued on page 26)

Spencer Chemical Company Acquires Natural Gas Reserve

The Sunflower Natural Gas Company, Inc., a wholly owned subsidiary of the Spencer Chemical Company of Kansas City, Mo., and Pittsburg, Kans., has recently purchased some 28,000 acres of mineral rights in Seward County, Kans., and Texas County, Okla., from Fred C. Koch and the Wood River Oil and Refining Company of Wichita, Kans. The transaction was completed on March 7, 1947, but has just been announced by the purchaser.

The Spencer Chemical Company reports that the purchase was made to assure the chemical and fertilizer company operating the Jayhawk Works near Pittsburg, Kans., an adequate supply of natural gas, which is used as a raw material, for many years to come. The purchase of these 28,000 acres located in the Hugoton gas field represents approximately a 30-year supply of natural gas for the processing requirements of the Spencer Chemical Company. Substantial quantities of coal will be used annually to generate power, thereby extending the life of gas, which is used for its chemical content and as a raw material to the manufacturing process, and not as a source of heat and power. The Spencer Chemical Company announced that the service from the present supplier of natural gas at the huge works had been most satisfactory, and this purchase was made simply to supplement the present supply of the pipe line company now furnishing natural gas for the chemical plant.

Spencer Chemical Company reconverted the war-operated facility, the Jayhawk Ordnance Works, into private commercial production in June, 1946. The efficient operation of this facility for the production of heavy chemicals continued uninterrupted from the first day of production on January 21, 1943, producing nitrates for the war effort. Since June 2, 1946, Spencer Chemical Company has produced chemicals for industry and agriculture and, in this brief period of commercial operation, proved to be an integral part of the heavy chemical industry of the United States. The company's production during the first ten months has been restricted to anhydrous ammonia, ammonium nitrate fertilizer, and ammoniating solutions used in agriculture. A substantial construction program is now under way and, when completed, plans will be diversified to include, in addition to the present products, methanol, dry ice, liquid carbon dioxide, refrigeration grade ammonia, technical grade ammonium nitrate, industrial nitric acid, and allied products.

The location of the Spencer Chemical Company in the mid-continent area serves as one of the initial large industries to find location adjacent to the natural resources of the area, which makes possible economical production of much-needed chemicals for industry and agriculture in this region. It is the belief of the company that the addition of a substantial supply of natural gas will add security and stability to the long-time operating plans of the company.

The officers of the Sunflower Natural Gas Company are: K. A. Spencer, president; L. H. Albus, vice-president; O. E. Miller, secretary, and John P. Miller, treasurer.

Chemical Construction Issues New Ammonia Plant Bulletin

A complete description of N. E. C. process synthetic ammonia plants is provided in a new brochure prepared by the Chemical Construction Corporation.

The 14-page bulletin includes comprehensive flow charts showing synthetic ammonia production from a variety of hydrogen sources—coke, hydrocarbon gases, or electrolysis of water. The process, by which nitrogen and hydrogen are made to combine under compression and in the presence of a catalyst, is fully described. Outlines of each phase of production, including gas purification, is included. Numerous photographs provide a visual tour of a typical Chemico ammonia plant.

Those interested in obtaining copies of this interesting brochure may do so by writing on their company letterhead to the Chemical Construction Corporation, 350 Fifth Avenue, New York 1, N. Y. Ask for Chemico Bulletin No. A-101.

Bemis Elects New Director

George H. Parsons was elected to the Directorate of Bemis Bro. Bag Co., at a recent meeting of the Board. A grandson of Judson M. Bemis, the founder of Bemis Bro. Bag Co., Mr. Parsons is a resident of Seattle, Washington, and has been active in the civic and business affairs of that area since his graduation from Harvard Business School in 1935. At present he is Treasurer of the Interstate Chemical Co., manufacturers of phosphate fertilizer.

THE AMERICAN FERTILIZER
ESTABLISHED 1894
PUBLISHED EVERY OTHER SATURDAY BY
WARE BROS. COMPANY
1900 CHESTNUT ST., PHILADELPHIA 3, PA.

A Magazine international in scope and circulation devoted exclusively to the Commercial Fertilizer Industry and its Allied Industries

PIONEER JOURNAL OF THE FERTILIZER INDUSTRY

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Atlanta, Ga.

ANNUAL SUBSCRIPTION RATES

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Single Copy	.25
Back Numbers	.50

THE AMERICAN FERTILIZER is not necessarily in accord with opinions expressed in contributed articles that appear in its columns.

Vol. 106 APRIL 19, 1947 No. 8

Principal Articles in This Issue

N. F. A. Policy Statement on State Legislation

At a meeting of the Board of Directors of the National Fertilizer Association held at Washington on April 10th, a general statement of policy regarding state fertilizer legislation was adopted. The discussion was occasioned by the proposal for a uniform state fertilizer law which had been made by a committee of Fertilizer Control Officials working with a committee of the American Society of Agronomy. The N. F. A. directors, while not referring to the model bill in their resolution, approve in general the objects of this bill, with the exception of the provision for an official list of grades in each state, to which fertilizer sales would be limited. The statement of policy is as follows:

Statement of Policy Regarding State Legislation

The National Fertilizer Association recognizes that agronomic and distribution problems involved in the manufacture and use of fertilizer are very largely local in nature and extent. For dealing with such problems no single legal formula can be found that would be suitable from coast to coast. This Association offers its services to State authorities in working out legislation that would be progressive and practical and would safeguard the interests of the users of fertilizers. As general principles that should be recognized in the preparation and administration of such legislation we suggest:

1. There should be required such disclosure of weight and chemical content by grade as will amply protect the farmer from fraud.

2. The fertilizer industry will welcome recommendations by State agronomists as to suitable grades for certain crops and soils and will cooperate in promoting the use of such grades. No legislation, however, should preclude individual initiative in research or prevent the farmer from exercising free choice in his selection and purchase of fertilizers.

3. Appropriate provision should be made in the laws to protect the farmer with respect to the fertilizer he buys.

4. In the administration of State fertilizer laws, the interests of all parties concerned should be protected from the possibility of arbitrary and capricious interpretations and regulations stemming from the vesting of wide discretionary powers in administrative officials.

Chase Bag Company Completes New St. Louis Plant

As part of their one hundredth anniversary celebration, The Chase Bag Company have announced the completion of their new St. Louis factory at 5033 Southwest Avenue.

In announcing the plants completion from the executive offices in New York, F. H. Ludington, President of the Company and a native St. Louisan, stated that the new and modern structure was one of the most complete and efficient plants of its kind ever erected, and a tribute to the century of achievement and satisfied customers who have made it possible.

W. K. Woods, St. Louis Manager, is enthusiastic about the increase in production and employment which the plant's modern facilities will permit.

The Chase Bag Company have maintained continuous operation in St. Louis since 1866 when their first western plant was opened by F. H. Ludington, grandfather of the present president. They were in their former location, 928 Spruce Street, for the past 20 years.

American Potash and Chemical Reports Record Production

Production and sales of the American Potash & Chemical Corporation attained an all-time high in 1946, the company has announced in its annual report.

During the calendar year 1946, the company's plant at Trona, California, manufactured 541,327 tons of primary chemicals, compared with 506,647 tons in 1945. In the same period total gross sales rose to $16,176,818, and net sales (value f.o.b. plant) reached $10,644,559.

Net earnings of $1,514,105.29 were reported by the company for 1946, compared with $1,176,366.01 in 1945. These earnings amounted to $2.87 a share for 1946 against $2.23 a share in 1945, an increase of about 30 per cent.

The rise in production was due to increased operating efficiency, continuing improvements in plant processes and reduction of labor turnover, the report stated. The company produces potash, borax, soda ash, salt cake, and other chemicals. The demand for these chemicals continued to grow, due to industrial expansion, particularly in the West.

To help supply this enlarged market, the company early in 1947 awarded a contract for construction of a new $3,800,000 plant which will increase the output of soda ash approximately 70 per cent and raise borax production about 30 per cent. A new power plant, which will increase the installed electrical generating capacity from 16,000 to 31,000 kilowatts, is expected to be completed in 1948.

During the year construction was started on a $310,000 addition to the research and engineering laboratory, scheduled for completion by May 1, 1947, and work also was begun on a two-story building in Los Angeles to house the company's executive and administrative offices and its western sales force.

Excess Fertilizer Values in North Carolina

The average plant food value in excess of the guarantee amounted to 43 cents per ton in North Carolina during the 1945–46 fertilizer year, according to figures compiled by D. S. Coltrane, Assistant Commissioner of Agriculture. In the aggregate, the farmers in that state received a total of $664,255.40 in these excess values.

Inspections in North Carolina totaled 5,289, from which there were only 46 seizures for violations of the state fertilizer law.

Obituary

E. L. Berry

Sudden death resulting from heart attack claimed E. L. ("Bill") Berry, of the Link-Belt Company, April 3rd, at the age of 52. Mr. Berry was Link-Belt vice-president in charge of production, with headquarters in Chicago.

Mr. Berry began his Link-Belt career in 1914, as machinist, at the company's Pershing Road plant in Chicago, after having been graduated from Williamson Trade School, and successively held the positions of rate setter, sub-foreman of shop, head of time study department, works engineer, general superintendent, assistant general manager.

During the war, Mr. Berry was vice-president and general manager of the wartime subsidiary Link-Belt Ordnance Company, now dissolved.

He became vice-president of the parent organization, Link-Belt Company, on Jan. 1, 1944. He was also a vice-president and director of Link-Belt Speeder Corporation.

March Tag Sales

Fertilizer tag sales in 16 States in March, based on reports of State control officials to The National Fertilizer Association, were equivalent to 1,120,000 tons. March sales were 23 per cent below the 1,460,000 equivalent tons reported for a year ago and 18 per cent below March, 1945; this reflects in part a shift in the seasonal distribution of sales.

Total tag sales in the 11 Southern States amounted to 960,000 equivalent tons, compared with 1,316,000 a year ago, a decrease of 27 per cent from sales last March. Of the 11 Southern States, only Louisiana and Oklahoma reported increases over last year while sales in the remaining 9 States showed decreases ranging from 4 per cent for Arkansas to 47 per cent for Alabama.

March tax tag sales in the 5 Midwestern States, amounting to 160,000 equivalent tons, were 11 per cent greater than in the preceding March. Tag sales in Kentucky and Kansas were below those of a year ago, but sales in the other 3 States showed increases ranging from 8 per cent for Indiana to 30 per cent for Illinois.

Tag sales in the Midwestern States represented 14 per cent of sales for all 16 States, compared with 10 per cent in March, 1946, and 8 per cent in March, 1945.

January-March sales, reflecting the decreased sales in the Southern States, amounted

(Continued on page 24)

FERTILIZER TAX TAG SALES

COMPILED BY THE NATIONAL FERTILIZER ASSOCIATION

STATE	MARCH				JANUARY–MARCH		
	1947 TONS	1946 TONS	1945 TONS	% OF 1946	1947 TONS	1946 TONS	1945 TONS
Virginia	95,780	121,236	101,009	91	261,130	288,463	248,065
North Carolina	210,008	296,836	292,216	88	791,730	895,197	822,138
South Carolina	120,765	191,301	196,930	85	445,930	522,510	505,978
Georgia	216,103	272,831	292,404	92	631,493	687,035	679,109
Florida	56,325	62,756	73,290	74	224,261	301,484	274,582
Alabama	100,250	190,600	164,000	76	387,600	507,050	471,000
Tennessee	47,832	75,720	52,875	64	101,790	159,091	119,250
Arkansas	29,200	30,450	21,550	131	94,000	71,950	69,950
Louisiana	33,950	24,450	25,275	93	85,580	91,810	88,086
Texas	40,405	43,265	35,745	103	139,244	135,552	100,125
Oklahma	9,840	6,748	3,600	169	35,740	21,098	11,662
Total South	960,458	1,316,193	1,258,894	87	3,198,498	3,681,240	3,389,945
Indiana	47,993	44,641	34,556	104	174,107	167,617	117,612
Illinois	30,695	23,575	16,850	123	126,645	103,008	75,925
Kentucky	44,478	45,855	29,052	106	160,731	150,938	117,445
Missouri	36,407	28,984	24,628	97	99,427	102,603	72,137
Kansas	300	728	710	178	19,898	11,209	12,915
Total Midwest	159,873	143,783	105,796	109	581,808	535,375	396,034
Grand Total	1,120,331	1,459,976	1,364,690	90	3,780,306	4,216,615	3,785,979

FERTILIZER MATERIALS MARKET

NEW YORK

No Improvement in Fertilizer Material Supply. Transportation Difficulties Also Hamper Production. Exports Increased and Imports Decreased during 1946. Feed Trade Taking All Organics at Prices above Fertilizer Levels. More Foreign Potash Hoped For.

Exclusive Correspondence to "The American Fertilizer"

NEW YORK, April 14, 1947.

No improvement in the supply situation on basic fertilizer commodities can be noted over past weeks. All items remain under heavy call from fertilizer manufacturers, and markets are exceedingly tight in most cases. Shipment of materials from producing points to manufacturers continues to be delayed by transportation difficulties and the result is a shortage of materials needed now for spring planting.

According to statistics prepared by the N. F. A. for the current year, 1946 exports of fertilizer materials from this country amounted to 1,265,000 short tons. This is an increase over the previous year of 23 per cent. It is interesting to note that 54 per cent of these exports went to countries within the Western hemisphere. Imports for the same period were 24 per cent lower than 1945, the decrease being largely accounted for by the smaller amounts of sodium nitrate imported from Chile.

Sulphate of Ammonia

The demand continues exceedingly active with available supplies decreasing as a result of the current slowdown in the coal industry. Some by-product producers have recently named higher prices, and it is felt that others will follow by raising their schedules shortly.

Nitrate of Soda

Supplies are exceedingly tight at a time when call is heaviest for this material. A recent arrival of about 4,000 tons from Chile will bring about a temporary easing of the supply situation in this area. Domestic production continues short.

Organic Materials

Buying interest from the feed trade has sutained the market at recent levels. Dried blood continues strong with sales reported at $9.50 ($11.55 per unit N) in this area. Tankage has been sold on the basis of $9.00 ($10.94 per unit N), New York. Some increase can be noted in the production of bone meal, but supplies move immediately to feed manufacturers as made available.

Superphosphate

In spite of efforts to relieve the shortage on boxcars for phosphate rock and tank cars for sulphuric acid, acidulators have been unable to obtain enough of these materials to meet the current demand for both ordinary superphosphate and triple superphosphate. Call is heavy in this area for shipment against current contracts, but few fertilizer mixers have been able to obtain adequate supplies.

Potash

Production at the mines remains short of satisfying buying interest, and resale material is practically non-existent. It is apparent that scheduled imports of French potash will have no appreciable effect on the present demand, and it is hoped that additional supplies may be brought to this market from other sources in Europe.

PHILADELPHIA

Fertilizer Material Supply Inadequate. Mixers Using U. S. P. Grade Potash. Some Increase in Material Prices Expected

Exclusive Correspondence to "The American Fertilizer"

PHILADELPHIA, April 14, 1947.

The general fertilizer picture is rather discouraging, with the demand very strong for all materials, and the supply decidedly inadequate. Some mixers are using U. S. P. grades of chemicals and actually paying drug store prices.

Sulphate of Ammonia.—The demand has been ahead of supply, and this situation will undoubtedly be aggravated by the recent closing of some of the coal mines. Some pro-

ducers have already notified the trade that shipments will be delayed.

Nitrate of Soda.—The requirements for top dressing are not being met, although recent arrivals from Chile will help some.

Blood, Bone, Tankage.—These organics are now offered a little more freely but at prices still too high for fertilizer use; and again the feeding people have backed out of the market. Blood has been offered at $9.00 to $9.50 per unit of ammonia ($10.94 to $11.55 per unit N), with tankage at $7.75 to $8.75 ($9.42 to $10.63 per unit N). The demand, however, is not strong. Raw bone has been quoted at $60 to $65, with steamed bone a little higher.

Fish Scrap.—This has been offered at equivalent to $10.25 per unit of ammonia ($12.46 per unit N), while fish meal figures $7.50 per ton higher.

Phosphate Rock.—This continues in tight position with call for more than can be furnished. Car shortage still delays shipments and production costs continue to rise.

Superphosphate.—Supply is not equal to the demand, and increased prices are shortly expected.

Potash.—Demand is very active and higher prices seem to be no deterrent. Current arrivals from Europe are costing more than the domestic potash, and, of course, the drug store grades are exceedingly expensive.

CHARLESTON

Mixed Goods Tonnage To Reach Record Heights in Spite of Material Shortage. Prices Remain Reasonable

Exclusive Correspondence to "The American Fertilizer"

CHARLESTON, April 15, 1947.

Shortage of all ingredients for fertilizer mixing remains great compared to demand, even though farmers will get more mixed goods than ever this year. Prices of mixed goods generally remain reasonable compared to the general commodity market.

Organics.—Call for organics by fertilizer manufacturers remains slack and feed buyers are the main support for the market on blood and tankages. Blood advanced recently and the market is firm at around $9.50 per unit ammonia ($11.55 per unit N) at Chicago. Some European nitrogenous was offered in the United States recently. Domestic nitrogenous sold recently at $4.75 ($5.77 per unit N) f. o. b. Midwestern production point for May/June shipment but not much is offered. Interest in South American organics is slight.

Castor Pomace.—No new offerings reported and movement is against contracts.

Hoof Meal.—Interest is slight and offerings are around $8.00 per unit ammonia ($9.72 per unit N) at Chicago.

Blood.—Dried ground blood is selling mainly to feeders at around $9.50 ($11.55 per unit N) f. o. b. Chicago.

Tankage.—Supplies are not being offered very freely and market remains firm around $9.00 per unit ammonia ($10.94 per unit N).

Nitrate of Soda.—Prices are firm at current levels but shortage is acute in Southeast. Deliveries from Chile are behind schedule. Domestic production remains curtailed due to soda ash shortage.

Sulphate of Ammonia.—Production is catching up a bit and some producers are almost on schedule against existing contracts. Demand, however, remains ahead of supply. Prices range from $30.00 to $32.00 per ton bulk at the ovens, depending on the producer.

Ammoniun Nitrate.—Demand outstrips supply and prices are firm.

Nitrogen Solutions.—A major producer has established a new price basis as follows: Solution 2A, 3 and 4 at $107.00 per ton of

nitrogen, f. o. b. Hopewell, Va., or South Point, Ohio, freight equalized with Belle, West Va., and Military, Kans., if lower.

Potash.—Spot supplies are scarce and demand tremendous. Little relief is expected for nearby months.

Superphosphate.—Stocks are low and demand very strong. Acidulation is curtailed by curtailed deliveries of rock and sulphuric acid—both being caused by shortage of boxcars and tankcars.

Phosphate Rock.—Demand is strong and deliveries behind schedule due mainly to shortage of boxcars. Price is reported increased 30 cents per ton recently due to increased cost of labor.

CHICAGO

Fertilizer Organics Practically Non-Existent. Feed Material Prices Dropping Somewhat

Exclusive Correspondence to "The American Fertilizer"

CHICAGO, April 12, 1947.

If Diogenes loaned his lantern to any of us in the fertilizer trade, we would have as much difficulty in finding animal organics which could be used advantageously, as the old gentleman had in locating an honest man.

After wet rendered tankage and unground blood touched $9.00 to $9.50 ($10.96 to $11.55 per unit N), f. o. b. shipping point, it eased off from $5.00 to $5.50 per ton, no doubt caused by lowered prices in other feeds and a slump on the demand.

Bemis Selects Florida Site for Southeastern Plant

Bemis Bro. Bag Company, a nation-wide manufacturing organization with headquarters in St. Louis, Mo., has leased buildings in the St. John's Shipbuilding Area of Jacksonville, Florida, and expects to commence operations about September, when alterations of the buildings and the installation of machinery have been completed.

The new plant will make and print open-mesh bags from cotton and paper for citrus fruits and fresh vegetables, and textile bags from cotton and burlap cloth, largely used for commercial feeds, fertilizer, and potatoes. Employment will be furnished initially for approximately seventy-five persons, mostly women.

L. L. Conrad, a native of New Orleans, and an employee of Bemis for over thirty-seven years, will manage the new plant. Mr. Conrad has served the company in various capacities and for several years prior to the war was manager of its Minneapolis plant. Throughout the war he occupied several Army administrative posts with the rank of Colonel.

According to company officials, Jacksonville was chosen because of its growing importance as an industrial center and the increased necessity of serving bag users in the southeastern states more efficiently.

Alfalfa May Rob Soil, Tests Reveal

The removal of three cuttings of alfalfa draws heavily on the soil for phosphorus, potassium and lime. When alfalfa is grown for several years on the same land, these elements must be replenished in the soil or the crop will suffer, declares H. J. Snider, agronomy department, University of Illinois College of Agriculture. Under suitable conditions alfalfa may supply a large part of the soil's nitrogen supply.

In some tests on the farm of Jeff Beazly near Mansfield, Illinois, three cuttings of alfalfa in 1946 removed plant food elements worth approximately $24 an acre. This alfalfa yielded about four and one-half tons of hay an acre, which contained a total of 260 pounds of nitrogen, 18 pounds of phos-

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Eye appeal rates high at the market place when fruit and vegetables are raised on a proper diet.

To get top consumer preference, the produce that goes to market must meet high standards of quality and appearance. Growers get more uniform results, therefore, when the fertilizer they use has been formulated to fit the crop.

Nitrogen That Fits the Crop

Efficient fertilizers supply nitrogen that will resist leaching till the plants need it most . . . then have it available in ample quantities. This is exactly the way Du Pont UREA-NITROGEN acts in the soil, when used as an ingredient in fertilizer mixtures.

There are four Du Pont UREA-AMMONIA LIQUORS, as well as URAMON Fertilizer compound. The Liquors produce quick-curing mixtures that store well, drill well, and have low acid reaction. E. I. du Pont de Nemours & Co. (Inc.), Ammonia Dept., Wilmington 98, Delaware.

phorus, 220 pounds of potassium and about 400 pounds of lime.

To replace these amounts in fertilizers and limestone would require an outlay of about $24. The nitrogen is largely charged off on the basis that legumes may take only about one-third of this element from the soil.

Fertilizer Means Early Pasturing

"Most upland pastures and meadows in Vermont will start growth from ten days to two weeks earlier in the spring if the right kind and amount of fertilizer is applied to them early," says Paul R. Miller, agronomist for the Vermont Extension Service.

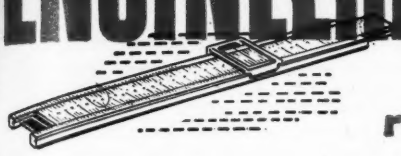
"This growth will mean that dairymen can reduce barn chores and feeding costs by turning cows out to pasture earlier. It also means that, on meadows that are not grazed, an early hay crop can be removed, giving an aftermath for summer grazing."

Mr. Miller reports that the kind and amount of fertilizer to be used varies with the type of soil, type of crop, drainage, and elevation. In general, the soils that respond best to early top-dressing with fertilizer, are those that are well drained, are at low to medium elevations, and that support a good stand of grass. Soils that are cold and poorly drained, that occur at high elevations and that support a poor stand of grass, usually show little response in early growth.

Nitrogen is the plant food that is mainly responsible for early growth and should therefore be included in all early top-dressing fertilizers, Mr. Miller advises. On soils that are well supplied with such minerals as phosphorus, potash and calcium, nitrogen alone may be used. Most any of the common nitrogen forms, such as nitrate of soda and sulphate of ammonia, may be used at the rate of from 300 to 400 pounds per acre. On soils where the mineral requirements are not entirely met, mixed fertilizers such as a 5–10–10, 7–7–7 or equivalent are recommended at the rate of from 400 to 800 pounds per acre.

For best results, the fertilizer should be applied as early as the ground will support machinery or horses without digging or punching, Mr. Miller suggests. On meadow land, early top-dressing will often increase tonnage from 1,000 to 2,000 pounds of hay per acre. Mr. Miller advises farmers who are interested in spring top-dressing to contact their county agricultural agents for specific recommendations.

ENGINEERED PACKAGING



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for chemical division of *United States Rubber Company*

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A few years ago company engineers noted a steady e in the cost of packing in fibre drums of two high- ced chemicals — anti-oxidants and accelerators used rubber compounding.

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- **Reduced container costs per ton of material packed**
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In addition, company engineers reported that Multiwalls gave efficient protection against contamination of these expensive chemicals . . . reduced dust in packaging . . . saved storage space . . . and won general acceptance from customers.

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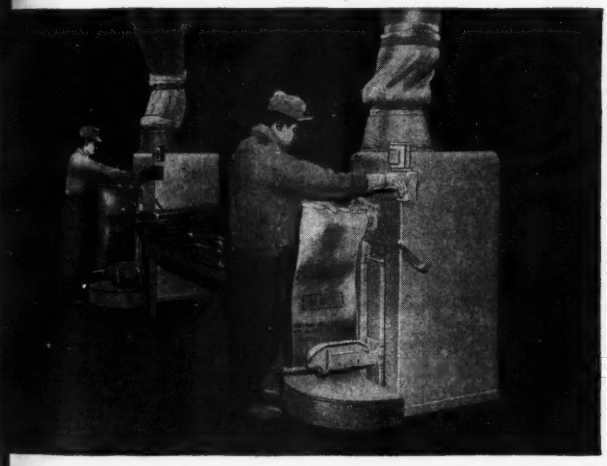

LEFT: *Only one operator is required for each valve bag packing machine.*

ABOVE: *Filled Multiwall bags stacked in the company's warehouse.*

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St. Regis Elects New Vice-Presidents

The election of William H. Versfelt and Edward G. Murray as vice-presidents of the St. Regis Paper Company, New York, was announced on April 14th by Roy K. Ferguson, president.

Mr. Ferguson also reported the election of two new directors, Ashley D. Pace and Gurdon W. Wattles, increasing the board to 19 members.

Mr. Versfelt is treasurer of both the St. Regis Paper Company and its sales subsidiary, the St. Regis Sales Corporation. Mr. Murray, executive vice-president of the sales corporation, directs the sales of printing, publication and converting papers. Mr. Pace is a vice-president and director of Florida Pulp & Paper Company and Alabama Pulp & Paper Company. Mr. Wattles was formerly associated with White, Weld & Co., where he was a partner for ten years.

Kentucky Farm Group Makes Big Tobacco Yield

More than 20 farmers within a radius of 3 miles in Monroe County, Kentucky, produced over a ton of tobacco to the acre last year. Although the majority grew Ky. 16, other varieties, such as Ky. 41A, Ky. 19 or Ky. 34, have been tried out during the past six years. Farm Agent Justus L. Ellis says that the best job these farmers have done is in building up their soil through the use of cover crops, all of them using vetch and crimson clover with some grain.

Take Jack Scott for instance. Ten years ago when he started reclaiming land which had been worn out for 40 years or more, he found it necessary to use lime and phosphate heavily in order to get a cover crop to grow. He has continued to seed crimson clover and vetch, and usually uses from 1,500 to 2,000 pounds of fertilizer to the acre. Gradually his soil has improved, until this year he sold more than a ton of tobacco to the acre on 1.4 acres for $1,400.

MARCH TAG SALES (Continued from page 16)

to 3,780,000 equivalent tons, representing decreases of 10 per cent from the similar period last year and 0.2 per cent from two years ago. First quarter sales for Arkansas, Texas and Oklahoma were higher than in 1946, but the remaining 8 Southern States reported decreases, from 7 per cent for Louisiana to 36 per cent for Tennessee. First quarter sales for the 5 Midwestern States, on the other hand, were 9 per cent over those reported for the same period a year ago, with only Missouri failing to show an increase.

Sales in the first 9 months of the current fertilizer year, from July through March, were considerably larger this year than last and were at an all-time peak.

July-March	1946–47	1945–46	1944–45
South	5,734,000	5,523,000	5,048,000
Midwest	1,382,000	1,121,000	905,000
Total	7,116,000	6,644,000	5,953,000

St. Regis Moves Allentown Offices

Burton A. Ford, Vice President of the St. Regis Sales Corporation and Manager of the Mid-Atlantic District, Multiwall Bag Division, announces the removal of the District headquarters office, now at 202 Farr Building, Allentown, Pennsylvania, to Room 9, 842 Hamilton Street, Allentown, Pennsylvania, effective April 1, 1947.

EXPLOSIBILITY AND FIRE HAZARD OF AMMONIUM-NITRATE FERTILIZERS

(Continued from page 12)

of oxidizing and exothermic reactions follows rapidly, raising the heat internally under insulating conditions to the ignition point. About 3 per cent ammonia added to the superphosphate will prevent the reactions causing combustion.

Bags and Other Containers

Of particular interest are the fire tests made by the Underwriters' Laboratories on bags used for storage of sulphate-nitrate mixture over periods of 3 to 10 months. The fabric contained about one ounce of absorbed salts per square foot, or 0.197 gram per square inch. Comparative tests were also made, using similar bags washed thoroughly and with bags containing one ounce of sodium nitrate per square foot. Test strips from the bags, 4 inches wide and 6½ feet long, were suspended by one end in a long sheet-iron box 12 inches square with mica windows. A gas flame 11 inches high was located 4 inches below a hanging bag strip. The periods of time necessary for ignition of the material, for combustion, and for afterglow of the specimens to remain visible were observed. The average ignition periods of the washed, the sodium nitrate, and the ammonium sulphate-ammonium nitrate strip were 4.33, 3.32, and 6.58 seconds, respectively; the average combustion periods in the same order were 86, 31, and 59 seconds; and the afterglow was 163, 360, and 560 seconds.

Tests at the Plant Industry Station laboratory were made with strips from burlap bags and from laminated (asphalt layer) paper bags, soaked in solutions of ammonium nitrate, sodium nitrate, and mixtures of salts, and compared as to burning properties after oven drying. When both salts were well dried, strips from bags soaked in sodium nitrate burned with more violence than those soaked in ammonium nitrate. The sodium-nitrate bag strips sputtered and dripped molten salt, and in these respects was in contrast to the quiet burning of the strips soaked in ammonium nitrate.

According to the National Fire Protection Association, "Oxidizing material, bags, or barrels may become impregnated with nitrate, in which condition they are readily ignitible. In contact with organic or other readily oxidizable substances it [nitrate] will cause violent combustion on ignition."

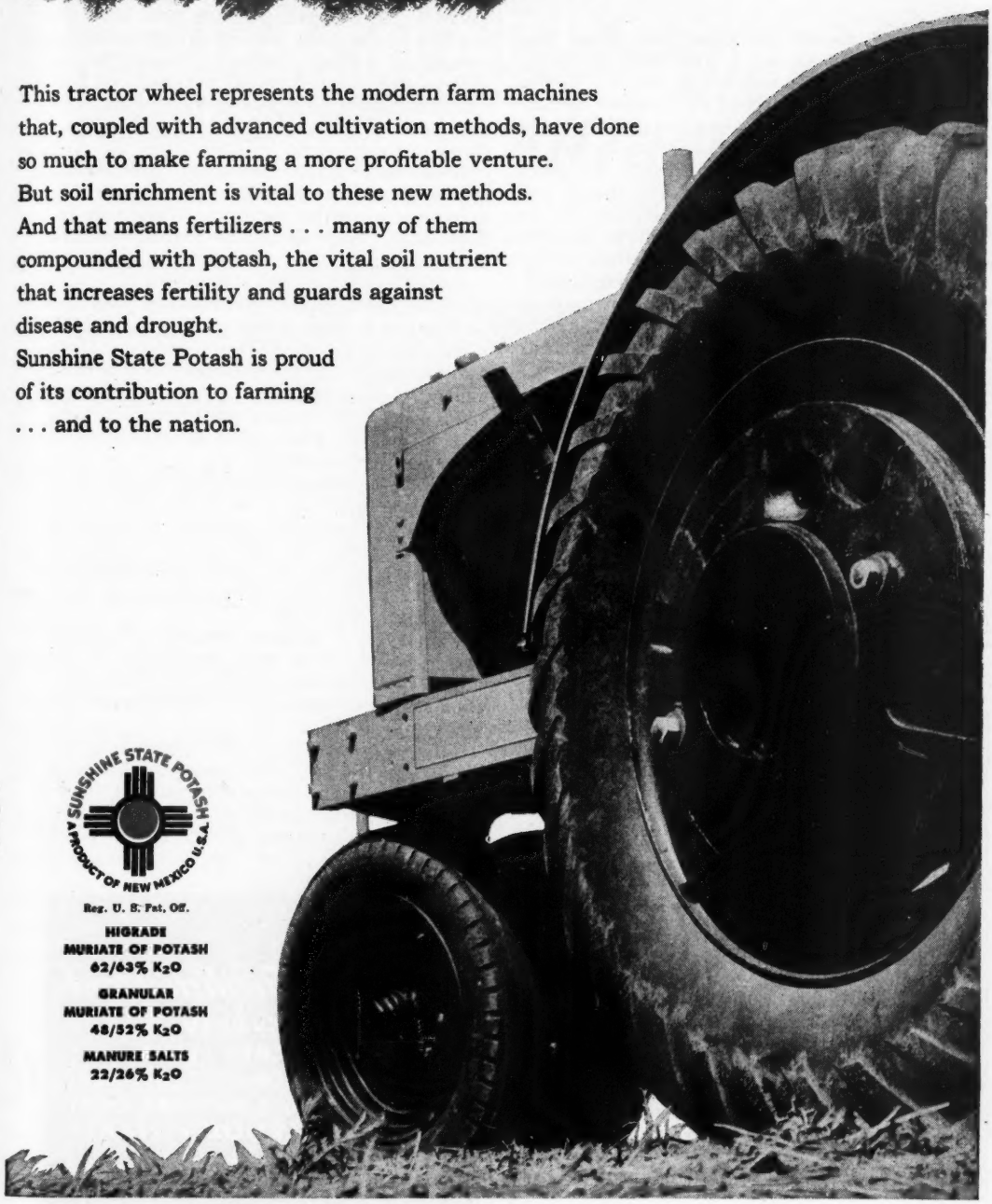
The results of the various tests indicate that paper or burlap bags impregnated with ammonium nitrate and mixtures of ammonium nitrate with other nitrogen carriers or sodium nitrate and dried, burn more vigorously than these materials without treatment, but the presence of ammonium nitrate makes the fabric no more combustible under most conditions than does sodium nitrate.

Kast concluded that wood and paper impregnated with ammonium nitrate is more difficult to ignite than the untreated material. When once ignited, however, the intensity of a fire is greater with such mixture under conditions in which there is free access of air. Fabric impregnated with ammonium nitrate heated to approximately 100° C. (212° F.) appears to offer a fire hazard, and,

NO WHEEL OF CHANCE . . .

This tractor wheel represents the modern farm machines that, coupled with advanced cultivation methods, have done so much to make farming a more profitable venture. But soil enrichment is vital to these new methods. And that means fertilizers . . . many of them compounded with potash, the vital soil nutrient that increases fertility and guards against disease and drought.

Sunshine State Potash is proud of its contribution to farming . . . and to the nation.



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UNITED STATES POTASH COMPANY, *Incorporated,* 30 Rockefeller Plaza, New York 20, N. Y.

as indicated in a previous section, prolonged heating at somewhat lower temperatures with easily oxidizable material may result in spontaneous combustion under some conditions.

Secondary Hazard of Ammonium-Nitrate Fire

A hazard associated with fires involving the presence of ammonium nitrate is the generation of dangerous fumes from decomposition of the nitrate at temperatures usually found in large fires. Large quantities of brown fumes, oxides of nitrogen, are given off. These are irritating to the throat and lungs and very dangerous if inhaled for an appreciable time. Often the effects from inhaling considerable quantities of these oxides do not appear severe for several hours afterward, when edema and even death may result. Special care should be taken not to inhale fumes from fires involving ammonium nitrate.

Safety Measures

Ammonium nitrate, untreated or treated, should be stored in a dry location, preferably fireproof, but, in any event, away from combustible material.

Laminated, waterproofed paper or fabric bags may be used for packaging these materials, and filled bags should be stacked to allow ample ventilation,

Combustible materials or easily oxidized metals, especially copper if finely divided, should be stored at a distance, in order to prevent accidental mixing with ammonium nitrate.

Mixtures containing acid salts or free acid, ammonium nitrate, and organic material should not be stored unless neutralized with ammonia.

Ammonium nitrate may be stored in bulk, only in a form definitely known not to cake in the time it will be stored. Bulk storage often results in severe caking, which makes it difficult to handle without blasting.

Caked ammonium nitrate should never be broken up by blasting with explosives.

Commercial fertilizer mixtures containing ammonium nitrate require no special precautions regarding explosions and may be handled in the same way as similar mixtures containing sodium nitrate. It requires the presence of more than 50 per cent of ammonium nitrate with ammonium sulphate to make the mixture explosible under violent shock-test conditions.

Bags that have contained ammonium nitrate should not be piled even temporarily in or near a wooden building, as they are inflammable. Bags should be burned promtly after emptying.

Bearing in mind that ammonium nitrate is explosive and supports combustion, it should be handled in such a way as to avoid conditions that would make it dangerous. More than ordinary caution should be practiced along the lines indicated, but no violent reactions need be anticipated from impacts, jars, or friction, which must be avoided with more sensitive explosives.

Should ammonium nitrate be involved in a burning building or in a fire with other combustible material, ordinary fire-fighting methods should be used to extinguish it. Water is generally the most convenient and effective; it will exert its usual cooling effect in extinguishing a fire.

Fumes from burning ammonium nitrate are extremely toxic and should not be inhaled. Persons who fight fires in which these chemicals are concerned should wear gas masks.

Mixtures containing superphosphate, organic conditioner, and ammonium nitrate may ignite spontaneously in storage if the temperature reaches 90° C. (194° F.); neutralization by ammonia eliminates this possibility.

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Titlestad Corporation, Nicolay, New York City

FERTILIZER (Mixed) MANUFACTURERS
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
International Minerals and Chemical Corporation, Chicago, Ill.
Virginia-Carolina Chemical Corp., Richmond, Va.

FISH SCRAP AND OIL
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
McIver & Son, Alex. M., Charleston, S. C.

FOUNDERS AND MACHINISTS
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Utility Works, The, East Point, Ga.

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HOPPERS
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Utility Works, The, East Point, Ga.

IMPORTERS, EXPORTERS
Armour Fertiliser Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga
Baker & Bro., H. J., New York City
Bradley & Baker, New York City.

INSECTICIDES
American Agricultural Chemical Co., New York City.
McLaughlin Gormley King Co., Minneapolis, Minn.

LIMESTONE
American Agricultural Chemical Co., New York City.
American Limestone Co., Knoxville, Tenn.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Bradley & Baker, New York City.
Longview-Saginaw Lime Works, Inc.., Birmingham, Ala.
McIver & Son, Alex. M., Charleston, S. C.

LOADERS—Car and Wagon
Hough Co., The Frank G., Libertyville, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Acid Making and Handling
Chemical Construction Corp., New York City.
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind
Utility Works, The, East Point, Ga.

MACHINERY—Ammoniating
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Company, Boston ,Mass

MACHINERY—Elevating and Conveying
Hough Co., The Frank G., Libertyville, Ill.
Hayward Company, The, New York City.
Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Utility Works, The, East Point, Ga.

MACHINERY—Grinding and Pulverizing
Bradley Pulverizer Co., Allentown, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Sedberry, Inc. J. B., Franklin, Tenn.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Utility Works, The, East Point, Ga.

MACHINERY—Material Handling
Hayward Company, The, New York City.
Hough Co., The Frank G., Libertyville, Ill.
Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Utility Works, The, East Point, Ga.

MACHINERY—Mixing, Screening and Bagging
Exact Weight Scale Co., Columbus, Ohio
Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Utility Works, The, East Point, Ga.

MACHINERY—Power Transmission
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind

MACHINERY—Superphosphate Manufacturing
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Utility Works, The, East Point, Ga.

MANGANESE SULPHATE
McIver & Son, Alex. M., Charleston, S. C.

MIXERS
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind
Sturtevant Mill Company, Boston, Mass.
Utility Works, The, East Point, Ga.

NITRATE OF SODA
American Agricultural Chemical Co., New York City.

NITRATE OF SODA—Continued
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.

NITROGENOUS ORGANIC MATERIAL
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
DuPont de Nemours & Co., Wilmington, Del.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.

NOZZLES—Spray
Monarch Mfg. Works, Philadelphia, Pa.

PHOSPHATE ROCK
American Agricultural Chemical Co. New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Ruhm, H. D., Mount Pleasant, Tenn.
Schmaltz, Jos. H., Chicago, Ill.
Virginia-Carolina Chemical Corp., Richmond, Va.

PLANT CONSTRUCTION—Fertilizer and Acid
Chemical Construction Corp., New York City.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Titlestad Corporation, Nicolay, New York City
Utility Works, The, East Point, Ga.

POTASH SALTS—Dealers and Brokers
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Schmaltz, Jos. H., Chicago, Ill.

POTASH SALTS—Manufacturers
American Potash and Chem. Corp., New York City.
Potash Co. of America, New York City.
International Minerals & Chemical Corp., Chicago, Ill.
United States Potash Co., New York City.

PRINTING PRESSES—Bag
Schmutz Mfg. Co., Louisville, Ky.

PYRITES—Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.

REPAIR PARTS AND CASTINGS
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Utility Works, The, East Point, Ga.

ROUGH AMMONIATES
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.

SCALES—Including Automatic Bagging
Sackett & Sons Co., The A. J., Baltimore, Md.

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SCREENS
Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Utility Works, The, East Point, Ga.

SEPARATORS—Air
Sackett & Sons Co., The A. J., Baltimore, Md.

SPRAYS—Acid Chambers
Monarch Mfg. Works, Inc., Philadelphia, Pa.

SULPHATE OF AMMONIA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Hydrocarbon Products Co., New York City.
McIver & Son, Alex. M., Charleston, S. C
Schmaltz, Jos. H., Chicago, Ill.

SULPHUR
Ashcraft-Wilkinson Co., Atlanta, Ga.
Texas Gulf Sulphur Co., New York City.

SULPHURIC ACID
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Virginia-Carolina Chemical Corp., Richmond, Va.

SUPERPHOSPHATE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Davison Chemical Corporation, Baltimore, Md.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Virginia-Carolina Chemical Corp., Richmond, Va.

SUPERPHOSPHATE—Concentrated
Armour Fertilizer Works, Atlanta, Ga.
International Minerals & Chemical Corporation, Chicago, Ill.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Virginia-Carolina Chemical Corp., Richmond, Va.

TANKAGE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.

UREA
DuPont de Nemours & Co., E. I., Wilmington, Del.

UREA-AMMONIA LIQUOR
DuPont de Nemours & Co., E. I., Wilmington, Del.

VALVES
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Utility Works, The, East Point, Ga.

Alphabetical List of Advertisers

PCA's RED INDIAN looks into the future

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We believe you know that PCA is doing two important things today . . .

1—Making every effort to give you best possible quality and service.

2—Looking ahead to the time when we can give you even better service.

We appreciate your business, your confidence and your patience. We know what your difficulties are today. We hope you appreciate ours. We look forward with confidence to future years of pleasant business relationship.

POTASH COMPANY OF AMERICA

CARLSBAD, NEW MEXICO

GENERAL SALES OFFICE . . 50 Broadway, New York, N. Y. • MIDWESTERN SALES OFFICE . . First National Bank Bldg., Peoria, Ill.
SOUTHERN SALES OFFICE . . Candler Building, Atlanta, Ga.

for greater security . . . tape bound . . . the Union Special closure for Paper Bags

The small sketch shows the tape bound closure produced by Style 21800 H machine equipped with 80600 H sewing head.

Here is the equipment for closing large size multiwall paper bags: Union Special's Style 21800 H table type bag closing machine with Style 80600 H sewing head. This unit is specially designed to produce a tight, durable, economical closure at high speed for any plant using multiwall paper bags. As illustrated in the accompanying sketch and picture, the machine applies a paper tape binding, folds it over the top of the bag, automatically inserts a filter cord, and sews through the bag top in a smooth, continuous operation. For easy handling of bags, standard units are equipped with a five-foot, adjustable, power-driven conveyor. The sewing head is also adjustable for bags of varying heights. For detailed description, ask for Bulletin No. 200.

Union Special Machine Company

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